10/580898
IAP20 Rec'd PCT/PTO 26 MAY 2006
[10537/327]

METHOD FOR PRODUCING A CORROSION-RESISTANT AND OXIDATION-RESISTANT COATING AND COMPONENT PART HAVING SUCH A COATING

The present invention relates to a method for producing a corrosion-resistant and oxidation-resistant coating. Furthermore, the present invention relates to a component part having such a coating.

When operating component parts, especially components of gas turbines, at high temperatures, their free surfaces are exposed to strongly corroding and oxidizing conditions. When used in gas turbines, such components may be made, for example, of a superalloy based on nickel or cobalt. To protect them from corrosion, oxidation and even erosion, the components are furnished with coatings that are produced from metal powders.

A method for producing a corrosion-resistant and oxidation-resistant slip layer is known from DE 198 07 636 C1. In the method described in that document, a slip material is prepared by mixing a binding agent solution with a starting material containing aluminum or chromium and an additive powder containing at least one element of aluminum, platinum, palladium or silicon, the additive powder not including aluminum in the case of a starting powder that contains exclusively aluminum. According to the method described there, the slip material thus prepared is subsequently applied to a component part and then cured. A heat treatment following the curing is used to diffuse the slip layer into the component.

Accordingly, in the method described in DE 198 07 636 C1, a binding agent, an additive powder and a starting powder are mixed, and this mixture is applied to the component. In the

method described, the starting powder is, for instance, pure aluminum, and the additive powder is, for example, pure platinum. When it comes to developing the corrosion-resistant and the oxidation-resistant coating, this is not without problem, since platinum has a tendency to oxidize in response to the heat treatment, and thus to the formation of platinum oxide, which impairs the formation of the coating. The binding agent may also have the effect of forming platinum oxide.

Starting out from this, the present invention is based on the problem of creating a new type of method for preparing a corrosion-resistant and oxidation-resistant coating, as well as a component part having such a coating.

This objective is achieved by a device in accordance with Patent Claim 1. According to the present invention, the method includes at least the following steps:

a) making available a component part made of a component part material,

b) making available a slip material which, besides a binding agent, contains at least one metal powder, the metal powder being made up of at least 25 wt.% of a metal of the platinum group, and

b1) is formed of jacketed powder cores, the powder cores being formed from at least one metal of the platinum group; and the jacketing of the powder cores being formed of a material based on the same material as the component part material, or

b2) is formed of a metal powder alloy which, besides the at least one metal of the platinum group, contains

at least one material based on the same material as the component part material,

c) applying the slip material at least from area to area onto the component part while forming a slip layer,

d) curing and drying the slip layer,

e) heat treating the component part that is coated with the slip material at least from area to area, in order to diffuse the slip layer into the component part.

According to one advantageous refinement of the present invention, the powder cores of the metal powder are formed of platinum and/or palladium, the jacketing of the powder cores being formed of the component part material of the component part that is to be coated. In the case of a turbine blade that is to be coated, which is made of a nickel-based alloy, the powder cores of platinum and/or palladium are jacketed using nickel or a nickel alloy. The jacketing of the metal of the platinum group suppresses the oxide formation of same, and thus has a positive influence on the formation of the coating.

Preferably, the metal powder is mixed with an aluminum powder and the binding agent to form a Pt-Al slip material, which is then processed within the meaning of the above steps c) through e).

The component part according to the present invention is characterized by the features of Claim 14.

Preferred further developments of the present invention are revealed by the dependent subclaims and the following description.

Exemplary embodiments of the present invention are explained in detail in light of the drawing without being limited to it. The figure in the drawing shows:

Figure 1: a gas turbine blade according to the present invention having a coating produced according to the present invention.

The present invention is explained in greater detail below, with reference to Figure 1. Figure 1 shows a blade 10 of a gas turbine, which includes a blade 11 as well as a blade root 12. In the present exemplary embodiment, blade 10 is provided all around with a coating 13, the coating 13 being applied onto blade 10 within the meaning of the method according to the present invention. Blade 11 may also be coated from section to section.

Blade 10 according to Figure 1 is preferably produced from a nickel-based alloy, and accordingly the nickel-based alloy forms the component part material for the component to be coated, namely for blade 10. At this point we should point out that the present invention is not limited to the coating of component parts that are produced from a nickel-based alloy. Using the present invention, component parts made of a cobalt-based alloy, an iron alloy or even a titanium alloy may also be coated.

Blade 10 according to Figure 1 is coated within the meaning of the present invention with the aid of a so-called slip method. For this, a slip material is made available. Within the meaning of the present invention, the slip material includes a binding agent or a binding agent solution as well as at least one metal powder, the metal powder being made up of up to at least 25 wt.% of at least one metal of the platinum group. At this point we should point out that the binding agent may be

an organic binding agent, and the binding agent solution may be a chromium phosphate solution. However, other binding agents are also able to be used.

Now, it is within the meaning of a first alternative of the present invention that a metal powder of jacketed powder cores is formed. The powder cores are formed of at least one metal of the platinum group. The powder cores are made up either of highly pure platinum, highly pure palladium or of a platinum-palladium mixture. These powder cores are furthermore jacketed according to the present invention. In this context, the jacketing material corresponds essentially to the component part material of the component part that is to be coated, and in the exemplary embodiment shown, it is the component part material of blade 10, that is to be coated. If blade 10, that is to be coated, is produced from a nickel-based alloy, the powder cores of the metal powder are jacketed either by nickel or a nickel alloy. If, on the other hand, a component part is to be coated that is produced from a cobalt-based alloy, the powder cores are jacketed either by cobalt or a cobalt alloy. In the case of a component part that is to be coated and is produced from an iron material, the powder cores of platinum or palladium are jacketed by iron or an iron alloy.

Thus, it is within the meaning of the first alternative of the present invention to use a metal powder for the slip material whose powder cores are formed of platinum and/or palladium, the powder cores being jacketed using a material whose composition essentially corresponds to the composition of the component part material of the component part that is to be coated.

According to a second alternative of the present invention, the metal powder is formed from a metal powder alloy which,

besides the at least one metal of the platinum group, contains a material based on the same material as that of the component part. The essential difference from the first alternative is that the jacketed powder cores alloy only upon being heated later, whereas the metal powder alloy is already alloyed.

According to one preferred specific embodiment of the method according to the present invention, a slip material is made available which, besides the binding agent, includes aluminum on the one hand, and on the other hand contains the above-described, jacketed powder cores, especially nickel-jacketed platinum cores or an equivalent metal powder alloy. In this way, an aluminum-platinum-nickel slip material is made available, which makes possible an especially preferred development of an aluminum-platinum coating on the surface of the component part that is to be coated, which in the exemplary embodiment shown is blade 10, that is to be coated.

For the sake of completeness, it should be pointed out at this point that the slip material, besides the binding agent and the jacketed powder cores or the equivalent metal powder alloy, of course is also able to have an MCrAlY metal powder and/or an NiAl metal powder and/or an NiCrAl metal powder. Accordingly, it is within the meaning of the present invention to make available a slip material which includes at least the binding agent or the binding agent solution, and, in addition, at least the metal powder of the jacketed powder cores or the corresponding metal powder alloy. In addition, aluminum powder or another metal powder may be contained in the slip material.

Within the meaning of the present invention, the slip material thus made available is applied to the component part that is to be coated, in the exemplary embodiment shown, that is blade

10. The application is made by brushing on, spraying on, dipping or another suitable method.

After the application of the slip material, while forming a slip layer on the component part, curing and drying of the slip layer takes place. The curing of the slip layer is performed within a temperature range of room temperature up to 450°C, preferably within a temperature range of 350°C to 450°C.

After the curing and drying of the slip layer, heat treatment of same takes place for the diffusion of the slip layer into the component part. The heat treatment preferably takes place within a temperature range of 750°C to 1250°C for approximately two hours. The heat treatment may be carried out under a protective gas atmosphere, for instance in argon. However, the heat treatment may alternatively take place also in a vacuum or a normal atmosphere.

Because of the use of a jacketed platinum core and/or palladium core as the metal powder, one avoids that the platinum and/or palladium oxidizes during the heat treatment or caused by the binding agent. Because of this, a clearly better coating of the component part is implementable.

Within the meaning of the present invention, the grain size of the jacketed powder cores or the equivalent metal powder alloy is in a range between 0.01 µm and 5 µm, preferably in a range of 0.2 µm to 0.5 µm. The particle shape of the jacketed powder cores is preferably spherical, in order to ensure a uniform jacketing of same. However, it is also possible to have the particles disk-shaped or plate-shaped.

Moreover, it is within the meaning of the present invention to determine the thickness of the jacketing of the powder cores

in such a way that the percentage proportion of the material of the powder cores lies in a range between 25 wt.% and 85 wt.%, and accordingly the proportion of the material of the jacketing lies between 75 wt.% and 15 wt.%. In the preferred exemplary embodiment, in which nickel-jacketed platinum is used as the metal powder, the thickness of the nickel jacketing being selected in such a way that the nickel proportion lies between 15 and 35 wt.% and the platinum proportion between 85 wt.% and 65 wt.%. As was mentioned before, alternatively a metal powder alloy powder having a corresponding composition may be used, that is, having 65 wt.% to 85 wt.% platinum and 35 wt.% to 15 wt.% of nickel.

Subsequently to the heat treatment of the component part coated with the slip material, for the diffusion of the slip layer into the component part, a separate aluminization of the component part may take place. An aluminum source is made available for this and aluminum is diffused into the component part that is to be coated.